INSPECTION TECHNICAL PROCEDURE

I-110

SAFETY REQUIREMENTS DOCUMENT DESIGN STANDARDS IMPLEMENTATION ASSESSMENT

January 21, 2003
Revision 4

Approved: ____________________________________ Date: ______
Verification and Confirmation Official

Concur: ______________________________________ Date: ______

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SAFETY REQUIREMENTS DOCUMENT DESIGN STANDARDS IMPLEMENTATION ASSESSMENT

1.0 PURPOSE

This procedure assesses the adequacy of the River Protection Project Waste Treatment and Immobilization Plant (WTP) Contractor's incorporation of the safety standards, stipulated in the Safety Requirements Document (SRD), into the design of the WTP facility.

2.0 OBJECTIVES

The objectives include:

- Assessing whether the design standards are implemented; and
- Assessing whether deviations from the implementation of the design standards are appropriately evaluated and addressed in accordance with Contract[1] requirements.

3.0 DEFINITIONS

The definitions included in the following references are incorporated by reference into this inspection procedure:

- DOE/RL-96-0006, *Top-Level Radiological, Nuclear, and Process Safety Standards and Principles for the RPP Waste Treatment Plant Contractor*, "Glossary."
- RL/REG-97-05, *Office of Safety Regulation Management Directives*, "Glossary" (the glossary also includes a list of acronyms that are incorporated by reference into this inspection procedure).

4.0 BACKGROUND

The requirement for the Contractor to implement the design standards into the SRD comes from the WTP Contract as delineated below:

(a) Section C.6, Standard 7, paragraph (d) provides requirements for development and implementation of an integrated standards-based safety management program.

[1] Contract DE-AC27-01RV14136, between DOE and BNI, dated December 11, 2000.

(b) Section C.6, Standard 7, paragraph (e)(2)(ii) requires the Contractor's integrated standards-based safety management program be developed to comply with the specific nuclear regulations defined in the effective rules of 10 CFR 800 series of nuclear safety requirements and with the regulatory program established in the following four documents:

DOE/RL-96-0003, *DOE Process for Radiological, Nuclear, and Process Safety Regulation of the RPP Waste Treatment Plant Contractor*

DOE/RL-96-0004, *Process for Establishing a Set of Radiological, Nuclear, and Process Safety Standards and Requirements for the RPP Waste Treatment Plant Contractor*

DOE/RL-96-0005, *Concept of the DOE Process for Radiological, Nuclear, and Process Safety Regulation of the RPP Waste Treatment Plant Contractor*

DOE/RL-96-0006, *Top-Level Radiological, Nuclear, and Process Safety Standards and Principles for the RPP Waste Treatment Plant Contractor.*

The SRD, Volume II, includes the Safety Criteria (SC) for nuclear and process safety, and engineering and design, which are the SC applicable to this procedure.

5.0 INSPECTION REQUIREMENTS

This inspection will assess the Contractor's implementation of the SC and design codes and standards as stipulated in the SRD, Volume II. In addition, an assessment will be made of the Contractor's process for changing the design requirements. This assessment will be conducted through interviews of the design staff, review of applicable procedures and codes of practice, and review of design activities and products.

5.1 Implementation of SRD Design Requirements

5.1.1 The inspector should verify the applicable SRD design standards have been incorporated into the design of selected important-to-safety civil-structural structures, systems, and components (SSCs). (Contract, Section C.6, Standard 7, paragraph (d); QAM, Policy Q-03.1, Section 3.4.3; and ASME NQA-1, Supplement 3S-1, paragraph 3)

5.1.2 The inspector should verify the applicable SRD design standards have been incorporated into the design of selected Safety Design Class and/or Safety Design Significant mechanical SSCs. (Same as Section 5.1.1, above) Guidance for the review to verify applicable SRD design standards in Appendix H have been incorporated into the corrosion/erosion allowance for important-to-safety (ITS) vessel and piping systems will be provided by Inspection Technical Procedure I-123, Corrosion/Erosion Evaluation Assessment.

5.1.3 The inspector should verify the applicable SRD design standards have been incorporated into the design of selected Safety Design Class and/or Safety Design Significant control, electrical, and/or instrumentation SSCs. (Same as Section 5.1.1, above)

5.1.4 The inspector should verify the applicable SRD design standards have been incorporated into the design of selected Safety Design Class and/or Safety Design Significant mechanical (ventilation) SSCs. (Same as Section 5.1.1, above)

5.1.5 The inspector should verify the applicable SRD design standards have been incorporated into the design of selected Safety Design Class and/or Safety Design Significant fire protection SSCs. (Same as Section 5.1.1, above)

5.2 Implementation of Criticality-Related Design Requirements

The inspector should verify SRD standards, selected to prevent nuclear criticality, were applied to the design of the facility. (Contract, Section C.6, Standard 7, paragraph (e)(2)(ii))

5.3 Deviations from the Implementation of the Design Standards

The inspector should verify that deviations from the SRD design requirements are justified and approved in accordance with prescribed requirements. (QAM, Policy Q-03.1, Section 3.4.3; and RL/REG-97-13, *Office of River Protection Position on Contractor-Initiated Changes to the Authorization Basis*, Section 3.6.)

6.0 INSPECTION GUIDANCE

6.1 Implementation of SRD Requirements

The inspectors should select one or more systems from a list of systems for which the Contractor has completed at least a Revision 0 design. The system or systems, in aggregate, should contain a representative sample of SSCs from the following design engineering disciplines:

- Civil-structural
- Mechanical
- Control, electrical, and instrumentation
- Mechanical (ventilation)
- Fire protection

From the systems selected, the inspectors should examine SSCs from each of the design disciplines. The codes and standards used for the design of each selected SSC should be compared with the appropriate referenced design requirements (codes and standards) in the SRD, Volume II, and any differences noted. All differences must have been justified in accordance with RL/REG-97-13, Section 3.6; QAM, Policy Q-03.1, Section 3.4.3, and

Contractor design change procedures. Conclusions about the effectiveness of the Contractor's implementation of design standards can then be drawn from the results of the examinations. If errors, deficiencies, or failures are identified, the inspectors should determine whether the problem resulted from an isolated mistake or reflects a fundamental program weakness. A program weakness could be manifested, for example, by inappropriate/insufficient training; poor intra-organizational or inter-organizational communications; several similar errors, deficiencies, or failures in one or more organizations, or lack of management oversight. In addition, the pervasiveness of the weakness should be evaluated by assessing the potential for the weakness in other parts of the WTP facility design. This evaluation should be conducted to identify inconsistencies or pervasive weaknesses in the implementation of the design standards, such as lack of coordination or documentation of coordination between the SRD-approved standards and the actual design.

The following SRD safety criteria (standards) apply to more than one type of component or design discipline. During review of selected SSC, the inspectors should consider the Contractor's implementation of these safety criteria.

- Defense-in-depth must be applied commensurate with the hazard to provide multiple physical and administrative barriers against undue radiation and chemical exposure to the public and worker. (SC 4.1-1 and SRD Volume II, Appendix B)

- The design of SSCs must address the impact of natural phenomena hazards (NPH). (SC 4.1-3 and SC 4.1-4)

- For SSC <u>not</u> intended to be functional following NPH, the design must address, to a lesser extent, the impact NPH will have on these SSC. (SC 4.1-4)

- The SSC designated as Safety Design Class must be appropriately protected against dynamic effects (e.g., the effects of missiles, pipe whipping, and discharging fluids) that may result from failures of moderate- and high-energy systems or other accident conditions. (SC 4.1-5)

- Vessels and piping should be designed to accommodate Reliability, Availability, Maintainability, and Inspectability (RAMI) considerations. (SC 4.2-3)

- Vessels and piping should be designed and manufactured from materials that accommodate corrosion/erosion and creep allowance. (SRD Volume II, Appendix H)

- Liquid and gaseous systems must receive continuous monitoring to detect the loss or degradation of their safe storage functions. As appropriate, the following must be monitored:

    - Temperature; pressure; radioactivity in ventilation exhaust and liquid effluent streams

    - Liquid levels

- Tank chemistry; condensate, and cooling water

- Generation of flammable and explosive mixtures of gases (SC 4.2-4).

Listed below (Sections 6.1.1 – 6.1.5) are examples of elements of standards that are applicable to selected SSC in each design discipline. The inspectors should randomly select, for verification, one or more of these or other standards that are included in the authorization basis for the selected SSC. Other standards may be more appropriate for the inspection due to maturity of the design, completion of design reviews, or inspector experience.

For the design disciplines listed below, select at least two Safety Design Class and/or Safety Design Significant SSCs. Obtain relevant design documents to be reviewed and determine if the design incorporates applicable SRD design criteria and standards. These documents include, for example, design criteria, design drawings, calculations, evaluations, hazard analyses, system descriptions, specifications, and design bases. The inspector should verify selected elements of the following attributes, as applicable, have been considered in these design documents. (QAM Policy Q-03.1)

6.1.1 Civil-Structural Design Engineering

Civil

1. For building designs, the applicable nominal loads (dead, live, soil, wind, snow, flood, and earthquake) are specified and accounted for in accordance with American Society of Civil Engineers (ASCE) 7-95. (SC 4.1-2, 3 and 4)

2. The damping factor used for seismic analysis is in accordance with ASCE 4-98, Section 3.1. (SC 4.1-2)

Structural

1. Concrete/Rebar materials and cement/water ratios are specified in accordance with American Concrete Institute (ACI) 349-01 for structures. (SC 4.1-2)

2. Seismic analysis for structures was performed in accordance with ASCE 4-98. (SC 4.1-2)

3. Stresses in steel structures are specified in accordance with American Institute of Steel Construction (AISC) N690-94. (SC 4.1-2)

6.1.2 Mechanical Design Engineering

Process Safety Piping

1. Designated piping materials comply with Chapter VIII, Part 7 of American Society of Mechanical Engineers (ASME) B31.3-96, *Process Piping Code*, Category M. (SC 4.2-2) Corrosion/erosion allowance is in accordance with

ASME Section VIII, Appendix E, *Suggested Good Practice Regarding Corrosion Allowance*.

2. Stipulated welding requirements comply with Chapter VIII, Part 9, Paragraph M328 of ASME B31.3-96. (SC 4.2-2)

3. Stipulated piping component materials comply with Chapter VIII, Part 7, Paragraph M323 of ASME B31.3-96. (SC 4.2-2)

4. Seismic design criteria stipulated for piping systems address criteria for earthquakes and other loading factors as required by DOE-STD-1020-94. (SC 4.1-3)

Components such as Tanks, Valves, Pumps, etc.

1. Pressure vessels, heat exchangers, and the pressure-retaining parts of pumps and valves are designed in accordance with the ASME Boiler and Pressure Vessel Code, Section VIII. (SC 4.2-2) Corrosion/erosion allowance is in accordance with ASME Section VIII, Appendix E.

2. Valve operators are environmentally qualified in accordance with Institute of Electrical and Electronics Engineers, Inc. (IEEE) 323-1983. (SC 4.4-2)

3. Heat exchanger shell minimum thickness is in accordance with Tubular Exchanger Manufacturers Association-B, C, or R Heat Exchangers Mechanical Standards. (SC 4.4-20)

6.1.3 Control, Electrical, and Instrumentation Design Engineering

Control Systems and Components

1. Tank/vessel level control and system flow control devices, which require single-failure protection, meet the separation criteria of IEEE 384-1992. (SC 4.3-5)

2. Control systems are designed so, once initiated automatically or manually, the intended sequence of protective actions of the executed features continue to completion in accordance with ISA S84.01-96. (SC 4.3-4)

3. Sensing lines for level-control systems meet the single-failure requirements of IEEE 379-1994. (SC 4.4-18)

4. Protective actions are automatically initiated in accordance with ISA S84.01-96. (SC 4.3-1)

Electrical Systems and Components

1. Electric power is supplied by two independent divisions of onsite power required by IEEE 308-1991. (SC 4.4-9)

2. For electric equipment and components (motors, transformers, switchgear, relays, breakers, etc.), a qualification program is required in accordance with IEEE 323-1983. (SC 4.4-2)

3. Electrical supply systems (standby power diesel generator, direct current power, alternating current instrument and control power), including electrical circuits, are independent as required by IEEE 384-1992. (SC 4.4-9)

4. Electrical supply systems have redundancy and/or diversity, as necessary, to meet the single failure criteria of IEEE 379-1994. (SC 4.3-2)

5. AC instrument and control power systems (ICPS ac) have sufficient energy to start and operate all required loads connected to the distribution system for each ICPS ac as required by IEEE 308-1991. Also devices required to shed load are assigned the appropriate safety class and meet the single-failure criteria of IEEE 379-1994. (SC 4.3-2 and 4.4-9)

Instrumentation Systems and Components

1. Instruments and alarms are stipulated for lead acid storage batteries as required by IEEE 484-1996, Section 5.5. (SC 4.4-9)

2. The design of parameters and displays includes concepts such as visibility, readability or legibility, ability to access information, the meaningfulness of the display format (i.e., understanding without interpretation), and the precision to which the output can be read in accordance with IEEE 1023-1988, Section 4.3.1. (SC 4.3-6)

3. Process instrumentation field devices that energize to trip discrete input/output (I/O) circuits apply a method (e.g., end-of-line monitor, such as pilot current continuously monitored to ensure continuity; the pilot current is not of sufficient magnitude to affect I/O operations) to ensure circuit integrity in accordance with Instrument Society of America (ISA)-S84.01-1996, Section 7.4.1.1. (SC 4.3-4)

4. For process instrumentation, the logic solvers are designed to ensure the process will not automatically restart when power is restored, unless the process hazards analysis indicates this is appropriate in accordance with ISA-S84.01-1996, Section 7.3.5. (SC 4.3-4)

6.1.4 Mechanical (Ventilation) Design Engineering

1. The allowable stress in the selected SSC is in accordance with ASME N509-1989. (SC 4.4-6)

2. The materials stipulated for ducts and duct supports are in accordance with ASME N509-1989. (SC 4.4-6)

3. Ventilation system fans are constructed in accordance with ASME N509-1989. (SC 4.4-6)

4. High-efficiency particulate air (HEPA) filters are designed and constructed in accordance with Underwriters' Laboratories (UL) 586-1990. (SC 4.4-6)

5. Air treatment systems are separate, redundant, and meet the single-failure criteria of IEEE 379-1994. (SC 4.4-5)

6.1.5 Fire Protection Design Engineering

1. Buildings in which radioactive materials are used, handled, or stored are fire resistant or noncombustible in accordance with National Fire Protection Association (NFPA) 801-1995, Section 3-5. (SC 4.5-2)

2. Penetration seals in fire barriers for electrical or mechanical openings are listed to meet the requirements of American Society for Testing and Materials (ASTM) E814 or UL 1479 in accordance with NFPA 801-1995, Section 3-6.3. (SC 4.5-3)

3. Drains for radioactive material handling areas are sized in accordance with NFPA 801-1995, Section 3-10.2.1. (SC 4.5-3)

4. A fire alarm system is provided in accordance with NFPA 801-1995, Section 4-8.3. (SC 4.5-7)

6.2 Implementation Of Criticality-Related Design Requirements

To ensure SRD standards, selected to prevent nuclear criticality, were applied to the design of the facility, the inspector should verify the following:

1. A process analysis was completed to ensure the process is subcritical under both normal and credible abnormal conditions in accordance with American National Standards Institute/American Nuclear Society (ANSI/ANS) 8.1-1983, Section 4.1.2. (SC 3.3-1)

2. Design, handling, packaging, transfer, and storage systems include margins of safety for nuclear criticality that are commensurate with the uncertainties in the data and methods used in calculations and in the nature of the immediate environment under accident conditions. (SC 3.3-2)

3. Process designs incorporate sufficient safety factors to require at least two unlikely, independent, and concurrent changes in process conditions before a criticality accident is possible. (SC 3.3-3)
4. Passive engineering controls are being considered as the preferred control method when criticality safety is a concern. (SC 3.3-4)

5. Nuclear criticality safety considerations and controls are being evaluated for accident conditions, normal operations, and before significant operational changes. (SC 3.3-5)

6.3 Deviations from the Implementation of the Design Standards

To ensure compliance with the Contract and authorization basis, design staff must be knowledgeable of Contract design requirements, the SRD standards, and the process for revising authorization basis documents. The Contractor is required to use RL/REG-97-13, Revision 9, (Contract Section C.6, Standard 7, paragraph (e)(2)(iii)), which provides methods acceptable to the Office of River Protection (ORP) for evaluating and implementing Contractor-initiated changes to the authorization basis. This position paper describes which changes to the authorization basis can be made without ORP approval, and which changes require prior ORP approval.

The inspector should interview at least two people from each engineering discipline to assess their knowledge of the authorization basis change process. During interviews with selected staff members, the inspectors should ascertain if the design staff are aware that, prior to approving designs that contain requirements that are not in accordance with the SRD and other authorization basis documents, they first must perform safety evaluations of all changes to the authorization basis. Depending on the outcome of the safety evaluation (see RL/REG-97-13 for specific options), the Contractor must either (1) obtain OSR approval prior to implementing the changes, or (2) if the changes meet certain criteria as defined in RL/REG-97-13, document the changes and notify the OSR within 30 days of completing revisions to authorization basis documents. For example, deletions or modifications of standards previously identified in the approved SRD, or changes that would result in an unreviewed safety question (USQ), must be submitted to the OSR in an amendment request before implementation. (SRD SC 7.4-1, 7.4-2, 7.4-4, and 7.4-5)

7.0 REFERENCES

DOE/RL-96-0004, *Process for Establishing a Set of Radiological, Nuclear, and Process Safety Standards and Requirements for the River Protection Project Waste Treatment Plant Contractor*, U.S. Department of Energy, Office of River Protection, 2001.

DOE/RL-96-0006, *Top-Level Radiological, Nuclear, and Process Safety Standards and Principles for the River Protection Project Waste Treatment Plant Contractor*, U.S. Department of Energy, Office of River Protection, 2001.

ASME Section VIII, Appendix E, Suggested Good Practice Regarding Corrosion Allowance, 2001-07-01.

Integrated Safety Management Plan, 24590-WTP-ISMP-ESH-01-001, Rev. 1e, , Bechtel National, Inc., 2002.

RL/REG-97-05, *Office of Safety Regulation Management Directives*, Rev. 2, U.S. Department of Energy, Office of River Protection, 2001.

RL/REG-97-13, *Office of River Protection Position on Contractor-Initiated Changes to the Authorization Basis*, Rev. 9, U.S. Department of Energy, Richland Operations Office, 2002.

Safety Requirements Document, 24590-WTP-SRD-ESH-01-001-01, Rev. 0, Bechtel National, Inc., 2002.

Quality Assurance Manual, 24590-WTP-QAM-QA-01-001, Rev. 1, 2002.

8.0 LIST OF TERMS

ACI	American Concrete Institute
ANS	American Nuclear Society
ANSI	American National Standards Institute
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
BNI	Bechtel National, Inc.
HEPA	high-efficiency particulate air (filter)
I/O	input/output
ICPS	instrument and control power systems
IEEE	Institute of Electrical and Electronics Engineers, Inc.
ISA	Instrument Society of America
ISMP	Integrated Safety Management Plan
NFPA	National Fire Protection Association
NPH	natural phenomena hazards
QL	Quality Level
RAMI	Reliability, Availability, Maintainability, and Inspectability
SC	Safety Criteria
SRD	Safety Requirements Document
SSC	structures, systems, and components
UL	Underwriters' Laboratories
WTP	Waste Treatment and Immobilization Plant

Attachments: None